DOCUMENT RESUME

ED 377 797 HE 027 981

AUTHOR	Stager, David A. A.
TITLE	Returns to Investment in Ontario University Education, 1960-1990, and Implications for Tuition Fee Policy. Discussion Series, Issue 5.
INSTITUTION	Council of Ontario Universities, Toronto.
REPORT NO	ISBN-0-88799-298-6; ISSN-1201-0502
PUB DATE	Dec 94
NOTE	32p.; For an earlier edition of this paper, see ED 310 705.
AVAILABLE FROM	Council of Ontario Universities, 444 Yonge St., Suite 203, Toronto, Ontario M5B 2H4 Canada.
PUB TYPE	Reports - Research/Technical (143)
EDRS PRICE	MF01 Plus Postage. PC Not Available from EDRS.
DESCRIPTORS	*Educational Policy; Foreign Countries; Higher Education; Intellectual Disciplines; *Investment; Sex Differences; Trend Analysis; *Tuition; *Universities
IDENTIFIERS	*Ontario; *Return on Investment

ABSTRACT

This analysis of Ontario's returns to investment and implications for tuition fee policy updates a 1989 publication titled "Focus on Fees." The paper examines: data on public and private return on investment (ROI) from university education, pattern of ROI rates over time, and impact of tuition fee levels on estimated ROI for various university programs. Variations for males and females and for different programs of study are reported. ROI was estimated using earnings data from Canada's 1991 population census. Results indicate that: (1) private ROI for male graduates in humanities and social, biological, and physical sciences range from 7 to 15 percent; 15 to 16 percent in law, engineering, and commerce; and almost 21 percent for medicine; (2) private returns for women are higher than for men, with the exception of medicine; (3) the decline in returns to higher education investment in the 1970s was a cyclical condition rather than the beginning of a long-term trend, as rates increased in the 1980s. The paper concludes that tuition fees could be increased substantially before a declining rate of return could be expected to have an effect on enrollment, and there could be a greater differentiation of tuition fees by program. Appendixes discuss data sources, study assumptions, and sensitivity of estimated returns to assumptions. (Contains 22 references.) (JDD)

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RETURNS TO INVESTMENT IN ONTARIO UNIVERSITY EDUCATION, 1960-1990, AND IMPLICATIONS FOR TUITION FEE POLICY

Discussion Series
- Issue 5 -

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RETURNS TO INVESTMENT IN ONTARIO UNIVERSITY EDUCATION, 1960-1990, AND IMPLICATIONS FOR TUITION FEE POLICY

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Discussion Series
- Issue 5 -

Council of Ontario Universities
Conseil des universités de l'Ontario
444 Yonge Street, Suite 203
Toronto, Ontario
M5B 2H4

December 1994

ISBN: 0-88799-298-6
ISSN: 1201-0502

Permission from the Council of Ontario Universities to use earnings data obtained by the Council from Statistics Canada is gratefully acknowledged. Neither of these organizations, however, bear any responsibility for the analysis reported here. I am also indebted to Jack Parkinson for his assistance with programming and computations.

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EXECUTIVE SUMMARY

Returns to Investment in Ontario University Education, 1960-1990 and Implications for Tuition Fee Policy is a technical paper which expands on, and provides an update on, the information and data in David Stager's 1989 publication *Focus on Fees*.

The paper focuses on three key areas: up-to-date data on the return on investment (ROI) from university education, the pattern of ROI rates over time, and the impact of the level of tuition fees on the estimated rates of return on investment for various university programs. Variations for males and females, and for different programs of study are also reported.

As the paper explains, a student chooses to pursue post-secondary education for a variety of reasons. One significant motivation is the potential to gain more secure employment and higher income. The investment that a student makes in his or her education includes tuition fees, books, and earnings deferred while at university. The data provided in the report indicate both public and private returns on investment in university education. Benefits to the individual may take the form of a better job and higher salary. Benefits accrue to society in the form of technological advancements and research breakthroughs, the supply of professionals such as doctors and dentists, and better educated business and political leaders. These and other returns justify the public investment in higher education.

Up-to-date data presented in the report allow for a review of rates of return over an extended period. Earlier reports indicated that post-secondary education did indeed yield substantial private benefits. These rates were shown to have increased in the United States and elsewhere during the 1950s and '60s to as much as 11.5 per cent. In 1974, the rate declined to 8.5 percent. In Ontario, there were comparable declines which continued until 1980. But by 1985, rates had increased substantially. This raised the question of whether the 1985 increase marked an ongoing trend or only a brief interruption in the pattern of decline. The more recent data presented in this report indicate that the increase in rates of return has continued.

Using data from 1990, Table 1 shows the rates of return for males and females. Private rates of return are higher for females than for males. There are also significant variations in returns by program of study. This suggests that there could be greater differentiation of fees between programs. For example, if fees were doubled for programs such as commerce or engineering,

rates of return for both male and female graduates would still be higher than those of social science graduates paying the current fee levels.

Tuition fee increases have been and continue to be a sensitive issue. As indicated in Table 2 of the report, even a dramatic increase in tuition fees would have a limited effect on rates of return. Doubling tuition fees would reduce the private rate of return for males by approximately 1.5 per cent. Eliminating tuition fees increases the rate of return by only two per cent. The paper further states that tuition fees could be increased substantially before a declining rate of return could be expected to have an effect on enrolment.

INTRODUCTION

Students' decisions about post-secondary educational alternatives are strongly influenced by the expected return on investment in further education. While students do not make explicit calculations of rates of return, they do respond to changes and differences in implicit estimates of these returns. Indeed, changes in the rate of return have generally accounted for more of the variation in enrolment than have changes in either fees or family income (Freeman, 1986). It can also be argued that the post-secondary enrolment growth in the 1960s was due less to the increase in the college-age population than it was to the higher participation rate based on favourable expectations about future earnings for university graduates (Vanderkamp, 1988). Similarly, the slower growth or decline in enrolments in the early 1970s was due mainly to a deterioration of economic conditions and students' employment expectations (Gordon, 1981). Since then, enrolment has increased more quickly, especially in the programs with the higher expected returns. Furthermore, the recent high enrolments of female students may be attributed in part to the higher expected rates of return for women than for men in most programs.

This paper has three purposes: first, to estimate the current (1990) return on investment in different university programs or fields of study in Ontario; second, to determine whether the increasing returns that were observed for 1985 have continued into this decade; and third – perhaps most important – to explore the effects of alternative tuition fee levels on the estimated returns for various programs.

ESTIMATING RATES OF RETURN TO EDUCATION

The return to educational investment is usually calculated in terms of the internal rate of return by comparing the benefits with the costs.[1] This measure is directly comparable with the yield

[1] The internal rate of return is the discount rate that will equate the discounted benefits and costs; that is, where the net present value is zero. This rate is found by iteration in the formula:

$$V_a = \sum_{t=1}^{n} \frac{B_t}{(1+i)^t} - \sum_{t=1}^{m} \frac{C_t}{(1+i)^t}$$

where V_a is the net present value at age a, C_t is the cost in year t, B_t is the benefit (adjusted earnings differential) in year t, m is the duration of the educational program, n is the working lifetime in years, and i is the discount rate.

rate on investment in physical capital. The internal rate of return to investment in university education can be calculated both for an individual student (private returns) and for the whole economy (total returns). For an individual, the benefits of education are numerous: the increased earnings of university graduates over those of high school graduates; a wider range of opportunities for employment and further education; social status and prestige; enjoyment of learning; and many more.

The student's costs of education include expenditures for tuition fees, books, supplies, other direct expenditures, and the net earnings forgone while not in the labour force. (Room and board and transportation expenditures should be included only to the extent that they exceed comparable costs that would have to be incurred by students in an alternative activity.) This comparison of the private costs and benefits is illustrated in Figure 1. The shaded areas show the cost components (forgone earnings, books, tuition fees, etc.) and the benefits (after-tax earnings differential) that are compared in calculating the rate of return. The actual monetary returns attributed to investment in university education are represented by the differentials between the earnings of university and high school graduates, as shown in Figure 2[2].

The benefits of education for the economy as a whole consist primarily of the benefits accruing to an individual graduate, plus 'externalities' – the benefits accruing to the rest of the economy. These include the increment in output from others whose productivity is indirectly affected by the higher levels of education; and other benefits such as technological progress, a better informed electorate, higher quality of political and business leadership, and so on. The economy's total costs of university education include the direct expenditures made by universities for salaries, books, supplies, and equipment; the implicit costs of depreciation and forgone interest on physical plant and equipment; tax exemptions; students' expenditures for books, supplies, net costs of accommodation and travel; and the value of the output forgone while students are not in the labour force.

While benefit-cost analysis of education has some shortcomings if improperly interpreted, the basic logic of the analysis is unassailable. This approach simply compares all benefits and costs associated with a particular program to determine whether there is a net gain or loss. The criticisms of benefit-cost analysis in post-secondary education are mainly concerned with the

[2] University graduates included in this analysis are persons with a bachelor degree, or with a doctorate degree in medicine, dentistry, veterinary medicine, or optometry. Persons with a master's degree or other doctorate degrees are not included. High school graduates are persons whose highest educational qualification is a secondary school graduation certificate.

earnings data: they are historical and may not represent future earnings; all of the earnings differential between two groups is attributed to formal education without allowing for "innate ability"; and the differential may simply be a premium employers pay for the screening process in university education (Blaug, 1985).

Figure 1

Private costs and benefits of investment in university education

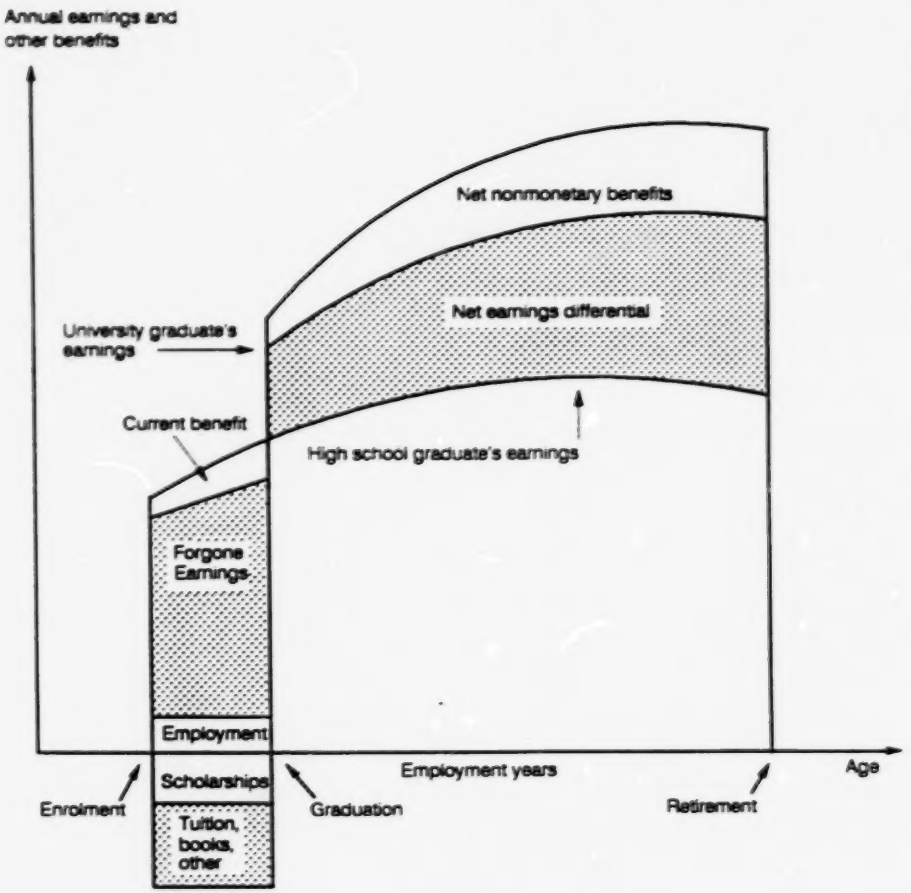
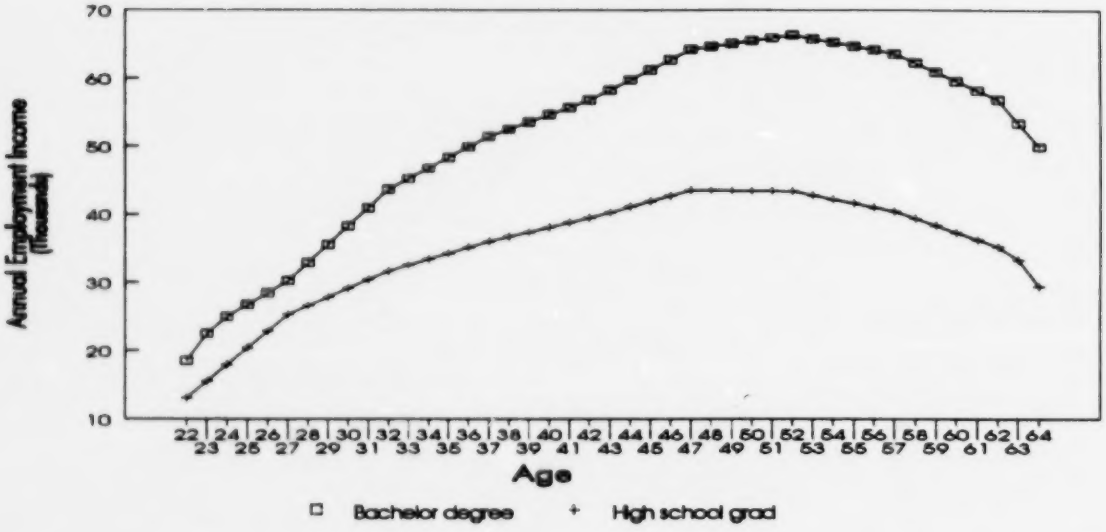
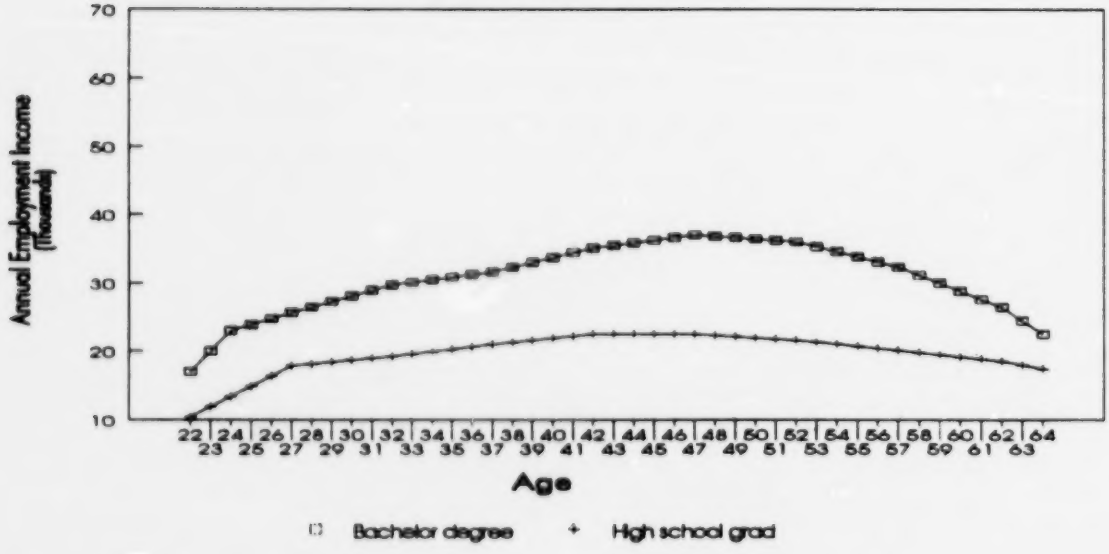


Figure 2

Lifetime Earnings, Males
Ontario, 1990



Lifetime Earnings, Females
Ontario, 1990



Although some of these objections are important when broad comparisons are made – such as between health and education programs – they are much less serious when similar programs are compared. The more important objections are: first, that much of the private non-monetary benefit and the external benefit is omitted from the calculation of total economic returns to education, but to this extent, the calculations underestimate the true returns; and second, that part of the earnings differentials between occupations may reflect different labour market structures or conditions, rather than a return to human capital. Comparisons of rates of return among different university programs of study avoid most methodological problems, however, because variations in externalities, ability, and screening effects are less significant within this group than between high school and college graduates.

RETURNS TO INVESTMENT IN UNIVERSITY EDUCATION, BY PROGRAM OF STUDY, 1990

The rates of return to various programs of study in Ontario universities, for 1990, are presented in Table 1. These rates can be compared in three directions: across programs, between genders, and for private and total investment in education.[3] The private rates of return for male graduates in humanities, social sciences, biological and physical sciences range from seven to 15 per cent; the rates are higher for law, engineering, and commerce (15 to 16 per cent), and are highest for medicine (almost 21 per cent).

A major part of the difference in returns may be related to genuine productivity differences, both in terms of variation in the number of hours worked per week and in productivity per hour. Moreover, there is a return to managerial enterprise in the case of many self-employed professionals, such as lawyers, accountants and engineers, who employ paraprofessionals.

The private returns for women are higher than for men – with the exception of medicine; indeed, the return for women is more than twice that for men in the case of humanities and the biological sciences.

3 See Appendix A for sources of data and assumptions used in calculating these rates of return.

Table 1

Rates of return for bachelor and first professional degree programs Ontario, 1990

Program	Private		Total	
	Males	Females	Males	Females
Humanities, Fine Arts	7.3	14.8	5.3	9.9
Social Sciences[a]	12.8	17.0	9.9	11.4
Commerce	16.2	21.8	12.7	14.8
Biological Sciences	6.8	15.0	4.7	9.9
Maths, Physical Sciences	15.1	21.2	11.5	14.6
Health Professions[b]	14.9	21.0	10.1	12.3
Engineering	16.0	19.8	11.5	12.6
Law	15.0	16.0	13.0	12.4
Medicine	20.8	19.7	14.4	11.8
All Bachelor Degree Programs	13.8	17.6	10.7	11.9

[a] Excludes Commerce, Social Work, and Law
[b] Includes Nursing, Pharmacy and Rehabilitation Medicine

The (total) rates of return for the whole economy are lower than the private rates in all cases. Although the before-tax income used in the total rate of return calculation is greater than the after-tax income used in calculating private rates, it does not offset the higher total cost because the income differential is greatest at higher ages where the differential is substantially discounted in the present value formula.

CHANGES IN THE RATES OF RETURN, 1960 TO 1990

There was a significant drop in the rate of return to university education during the 1970s. This decline was symbolized in the titles of two articles that appeared with a fifteen-year interval: in 1960 Becker published the pioneering article, "Underinvestment in College Education?"; in 1975 Freeman responded with an article titled "Overinvestment in College Training?". Freeman also attracted much attention with his book, *The Over-Educated American*, in which he reported earlier findings: the average private rate of return for male[4] graduates of American four-year colleges had been about 11.0 per cent from 1939 to 1959, increased to 11.5 per cent in 1969 and then dropped to 10.5 per cent in 1972 and to 8.5 per cent in 1974 (Freeman, 1976). A similar decline during the 1970s was found in private rates of return in the United Kingdom for male university graduates, especially those in science and engineering (Wilson, 1980). Indeed, a review of studies from many countries suggested that this decline was a global phenomenon (Psacharopoulos, 1989).

Comparable estimates for Ontario show that the average private rate of return for male university graduates dropped from 17.4 per cent in 1960 to 12.2 per cent in 1970; it had declined further by 1980, to 9.9 per cent[5]. But the decline in returns to higher education in the 1970s was a cyclical condition rather than the beginning of a long-term trend. Since then, the rates of return have increased rather sharply; by 1985, the private rate of return for male graduates of Ontario universities was 14.0 per cent (Stager 1989). The estimates reported in this paper show that rate

4 Calculations of rates of return are based on male graduates because female graduates formerly had much lower labour force participation rates and were concentrated in a few occupations. Their labour force experience has changed substantially in three decades, such that reliable calculations can be made for the later 1980s.

5 Other results for Canada and/or Ontario for the period 1960 to 1985 have been reported by Mehmet (1977), Cousineau and Vaillancourt (1987), Vaillancourt and Henriques (1986), Vaillancourt (1993), and Constantatos and West (1991), but variations in the data and/or assumptions used in each of these studies prevent direct comparisons with the results reported here.

continued at virtually the same level (13.8 per cent) to 1990. Other studies reported a similar upturn in rates of return in the United States during the 1980s (Cohn and Hughes, 1988).

This rise in the rates of return has been attributed to the slower increase in supply of new graduates than in the demand for their services (Murphy and Welch, 1989). This would confirm Freeman's forecast that the relative earnings of new college graduates would "improve moderately in the 1980s and rapidly in the later 1980s, though not to the boom conditions of the 1960s" (Freeman, 1976:187).

IMPLICATIONS FOR UNIVERSITY FINANCE AND TUITION FEE POLICY

The long cycle in the rates of return, from 1960 to 1985, shows the need to take a long view in planning and financing university education. During the 1960s, economists advised governments to increase investment in higher education because the returns on this investment were higher than for most other economic activity. Governments were happy to have this rationale for educational policies that were already well under way. The result was not only a rapid increase in university enrolment, but also a substantial increase in the real expenditure per student.

But the declining returns to this investment in the 1970s caused governments to react too quickly with 'cutbacks' to educational spending, instead of recognizing that the economy needed time to adjust to the substantial increase in the supply of graduates, and to the higher average level of skills in the labour force.

Meanwhile, two basic changes were occurring in the labour market: first, with higher consumer incomes and changes in technology, the demand for graduates' services increased more quickly; and second, the graduates of the 1960s were acquiring the experience that must complement formal education to produce the payoff in higher earnings. By 1985, the graduates of 1965 were in their early forties and were approaching the peak earning years of ages 45 to 55. The result was the rise in the return on investment in university education.

In assessing the significance of the rates of return for public policy purposes, it should be recalled that the rates omit most external benefits and therefore provide a lower estimate than the true rate of return on educational investment. Nonetheless, the returns are high when compared with other uses of economic resources. The total rates of return can be compared with the 10 per cent rate that is used by government agencies, such as the federal Treasury Board, because it approximates the real pre-tax rate of return on private investment (Vaillancourt and

Henriques, 1986). The private rates of return can be compared with the rate of three per cent that approximates the real after-tax return on private capital (Burgess, 1981).

Based on these benchmarks, one can conclude that the allocation of resources to university education remains a rational investment from the perspective of the whole economy. Even if externalities were not valued highly, the direct monetary returns alone would be more than sufficient to warrant an increase in the level of resources used in university education. The possible exceptions are for males in humanities and biological sciences, where the returns are only about five per cent. But since a large fraction of graduates of these programs are in teaching, where salaries and the demand for teachers are determined by public policy, the return to investment in these fields may be strongly biased by public sector salary policies.

While the total rates of return indicate that the economy's allocation for university education is rational, (and should be increased in most fields), this does not necessarily mean that the current sharing of costs between students and taxpayers is at the appropriate level. Because the private rates of return in all fields are quite high by comparison with the three per cent criterion reported by Burgess, the private share of the cost could be increased substantially before the declining rate of return would result in lower enrolment. (It should be noted that a private rate of return on education of ten per cent is an after-tax return of ten per cent annually for forty years. No other personal investment can begin to compare with this rate of return.)

The effect on the rates of return of shifting the private-public cost ratio is shown by the data in Table 2. A doubling of the tuition fee (i.e., a 100 per cent increase - from $1950 to $3900) would reduce the private rate of return for males by only about 1.5 percentage points. Alternatively, abolition of tuition fees would increase the rate only by about two percentage points. More important, doubling the fees - which would increase the private share to about 40 per cent of the total direct cost - would leave the private rate of return in the range of 10 to 20 per cent for most programs.

In the case of women, doubling the tuition fee would reduce the rate of return by about three percentage points, but - with the exception of medicine - would still leave them with a higher return than for men. Furthermore, the rates of return for women would still be in the range of 12 to 19 per cent, and would remain a strong economic incentive for enroling in any of the university programs.

The effect of incremental changes in tuition fees on the rates of return for men and women (all bachelor degree programs) can be seen in Figure 3, where fees are changed by 10 per cent steps in each direction from the current level. For example, this graph shows that the 10 per cent increase in tuition fees that has been announced by the Ontario government for each of 1994-95 and 1995-96 will reduce the private rates of return by less than one-half of a percentage point.

The greater sensitivity of women's rates of return to changes in fees is explained by their higher ratio of fees to forgone earnings. (Table A3 in the Appendices shows that women's forgone earnings are about three-quarters of men's forgone earnings.) Consequently, changes in fees represent larger relative changes in women's total costs.

Comparisons of the rates of return across programs of study also suggest that there could be a greater differentiation of tuition fees by program. For example, if fees were to be doubled for commerce, engineering, law and medicine, the rates of return for both men and women (with the exception of female law graduates) would still exceed the rate of return in the social sciences at the current fee level.

CONCLUSIONS

Because students view their post-secondary education primarily as an investment that is expected to result in wider employment options and higher incomes, it is important to estimate the rates of return to these investments over time and across fields of study. The internal rates of return to university education in Ontario are higher than for many other private and public projects, differ greatly across programs, and generally are higher for women than for men. These results are a major factor in the increasing participation rate in university education, especially for women.

The study's results also show that the higher returns to education in the early 1980s, following a decline during the 1970s, have continued through to the beginning of this decade. Most important, the estimates presented here show that major changes in tuition fees have little effect on the rate of return. This is because tuition fees are such a small portion of the student's total cost of university education. While it is not the purpose of this paper to propose a specific share for the private contribution to the total cost of university education, it does suggest strongly, however, that a major change in the level of fees would likely have very little impact on enrolment. It also presents preliminary evidence that would support a greater differentiation of fees across university programs, possibly in proportion to their rates of return on investment.

Table 2

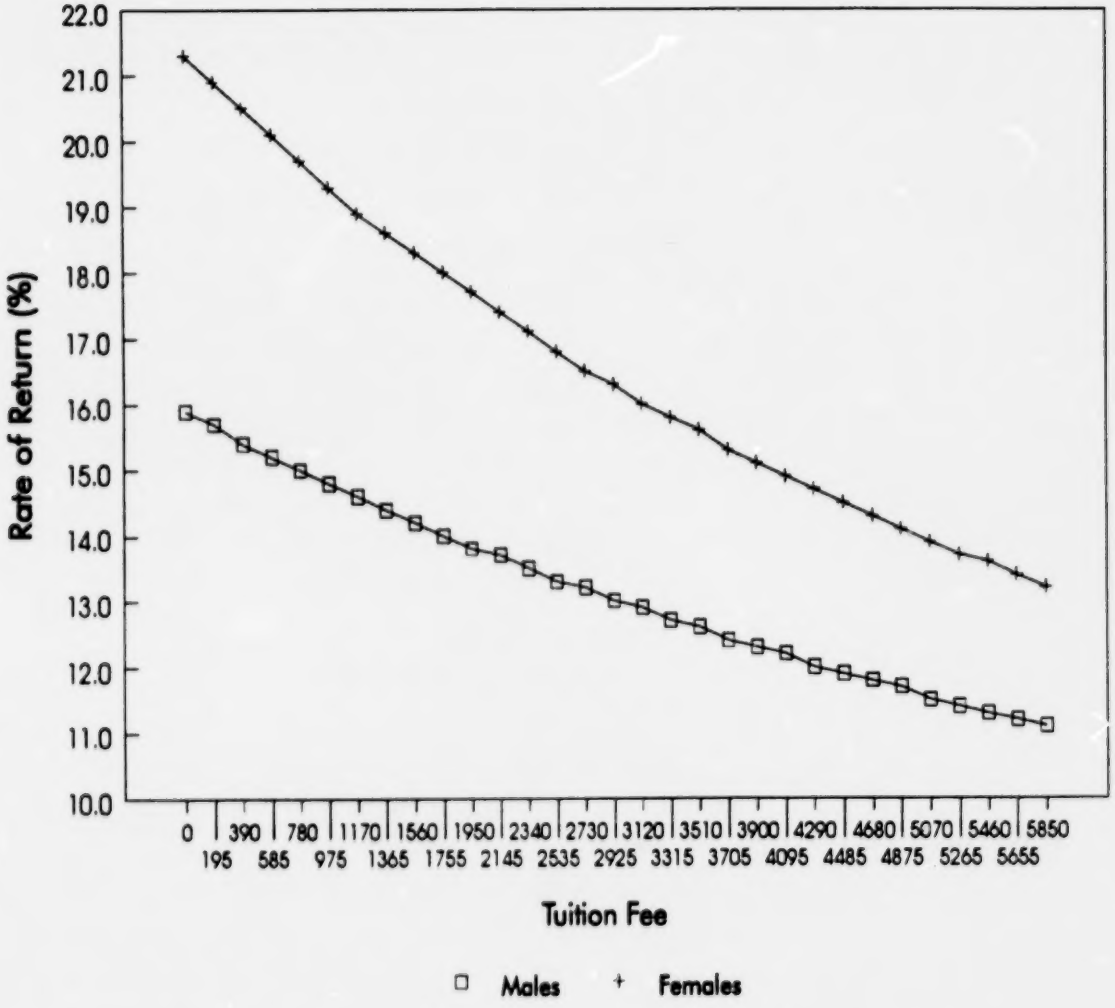
Private rates of return, under alternative tuition fee levels, for bachelor and first professional degree programs, Ontario, 1990

Program	Tuition					
	Males			Females		
	zero	current	double	zero	current	double
Humanities, Fine Arts	8.5	7.3	6.4	17.7	14.8	12.7
Social Sciences[a]	15.1	12.8	11.1	21.5	17.0	14.1
Commerce	18.5	16.2	14.5	26.1	21.8	18.7
Biological Sciences	8.5	6.8	5.7	19.0	15.0	12.4
Maths, Physical Sciences	17.5	15.1	13.4	25.3	21.2	18.3
Health Professions[b]	17.3	14.9	13.0	25.3	21.0	17.9
Engineering[c]	18.3	16.0	14.3	23.2	19.8	17.3
Law	16.3	15.0	13.9	18.2	16.0	14.3
Medicine[d]	22.7	20.8	19.3	22.1	19.7	17.7
All Bachelor Degrees	15.9	13.8	12.3	21.3	17.6	15.1

[a] Excludes Commerce, Social Work, Law
[b] Includes Nursing, Pharmacy, and Rehabilitation Medicine
[c] Includes Architecture
[d] Includes Dentistry, Veterinary Medicine, and Optometry

Figure 3

Private Rates of Return Under Alternative Fees



APPENDIX

DATA AND ASSUMPTIONS

Rates of return to university programs were estimated using earnings data provided by Statistics Canada from the 1991 population census of Canada. (See Table A1 for data on the mean earnings by age-group for graduates of various university programs. Table A2 shows earnings for high school graduates.) Earnings include wages and salaries plus self-employment income for part-time and full-time workers for the calendar year 1990.[6] The earnings were adjusted for life expectancy[7] and labour force participation.[8] For calculations of the private rates of return, the earnings were also reduced by the amount of personal income tax.[9]

The implicit costs of earnings forgone while attending university are based on the employment income for high school graduates, for ages 19 to 24, also obtained from the 1991 census. (See Table A3.) The actual forgone earnings were adjusted upward on the assumption that university students would have earned more than the average for high school graduates.[10]

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6 Calculations are based on mean earnings by individual year of age, as estimated by interpolation from the five-year age-group data.

7 Life expectancy at each year of age was based on mortality tables, by gender, for Ontario for 1980-82, the most recent period for which data are available. (Statistics Canada, *Life Tables, Canada and Provinces 1980-82, no. 84-532.*)

8 Labour force participation rates by gender and educational level for Ontario were estimated from data for 1986. (Statistics Canada, *Census of Canada, 1986.*)

9 The income tax adjustments were based on the effective rates of federal and Ontario tax on total income, by detailed income class, for 1990. (Revenue Canada, Taxation Statistics, 1992 edition, summary table 2.)

10 The assumed differential in the 1968 study was 16 per cent for males and 10 per cent for females; the same differential was used in this study to permit a direct comparison of results. One could also rationalize the opposite adjustment. Willis and Rosen (1979) have estimated that those who attend university would have earned less as high school graduates than measurably similar people who entered the labour force directly from high school.

Table A1

Mean employment income for bachelor and first professional degree graduates, full-time and part-time workers, Ontario, 1990

Males										
Age	Bachelor	Humanities	Social Sciences	Physical Sciences	Biological Sciences	Commerce	Health Professions	Engineering	Law	Medicine
22	18,500	20,000	19,000	20,000	20,000	20,000	20,000	20,000	-	-
23	22,500	21,000	23,000	24,000	21,000	24,000	24,000	26,000	-	-
24	25,000	22,000	25,000	28,000	23,000	27,000	28,000	30,000	19,000	30,000
25-29	30,228	23,554	27,792	32,187	24,487	31,012	32,530	34,213	27,873	46,665
30-34	43,632	35,104	41,585	43,759	35,763	47,826	45,704	44,957	63,230	84,416
35-39	51,483	41,807	48,630	51,558	41,320	56,128	47,698	52,059	86,868	112,406
40-44	56,812	47,017	55,221	56,302	46,376	61,909	51,773	56,137	101,218	124,805
45-49	64,222	53,324	63,419	62,888	49,914	65,284	57,187	63,527	118,931	133,531
50-54	66,340	55,015	69,929	58,982	44,222	69,671	59,928	67,424	118,561	139,627
55-59	63,590	48,726	59,854	56,481	46,734	58,047	54,277	69,211	121,064	124,747
60-64	56,914	41,920	52,924	55,817	47,412	64,045	54,872	59,806	99,353	110,850
Females										
Age	Bachelor	Humanities	Social Sciences	Physical Sciences	Biological Sciences	Commerce	Health Professions	Engineering	Law	Medicine
22	17,000	17,000	18,000	20,000	17,500	20,000	20,000	20,000	-	-
23	20,000	19,000	21,000	23,000	20,000	23,000	23,000	24,000	-	-
24	23,000	20,000	22,500	25,000	21,000	26,000	26,000	27,000	18,000	25,000
25-29	25,628	21,930	24,245	28,242	22,634	28,463	30,345	31,485	28,183	37,581
30-34	29,768	26,894	27,157	33,921	27,472	33,851	28,690	33,362	45,790	56,672
35-39	31,637	28,986	29,445	35,202	28,561	33,629	30,943	35,205	62,257	64,374
40-44	35,147	32,500	35,096	36,432	30,458	36,533	34,646	34,948	53,480	75,250
45-49	37,012	34,828	37,759	37,894	35,168	36,166	34,637	32,059	60,405	81,199
50-54	36,027	33,966	36,672	36,268	26,465	35,545	35,732	33,678	40,080	76,735
55-59	32,346	30,620	32,122	31,210	25,035	34,526	38,065	37,235	43,765	71,908
60-64	26,384	24,802	28,061	21,257	20,418	28,053	26,122	43,745	54,518	52,598

Table A2

Mean employment income for high school graduates, full-time and part-time workers, Ontario, 1990

Age	Males	Females
22	13,050	10,390
23	15,500	11,888
24	17,948	13,392
25-29	25,297	17,880
30-34	31,672	19,262
35-39	35,992	21,024
40-44	39,434	22,508
45-49	43,475	22,454
50-54	43,327	21,598
55-59	40,371	20,126
60-64	35,163	18,528
65-69	25,531	15,736

The students' costs and the institutions' costs for each program are shown in Table A4. Data for students' costs are estimated from *A Profile of Post-Secondary Students* in Canada, Statistics Canada, 1987. Direct institutional costs are based on the value of the basic operating income, consisting of the provincial government grant, multiplied by the weight that is assigned to each enrolment in a specific program, plus the tuition fee for that program. Indirect institutional costs include depreciation and forgone interest associated with fixed assets, and tax exemptions for educational institutions.[11]

SENSITIVITY TO ASSUMPTIONS

The sensitivity of estimated returns to the assumptions employed in this study was tested in alternative calculations. Estimates based on cross-sectional earnings data are sometimes criticized for not taking account of expected real economic growth over a graduate's lifetime. But the effect of real growth can easily be estimated. For example, an assumption of a 2 per cent annual growth in real income over the graduate's working lifetime would add two percentage points to the calculated rate of return since the compounded growth rate is symmetrical with the compounded discount rate, that is, the estimated internal rate of return.

Studies have also shown that part of the observed earnings differential associated with higher levels of education can be attributed to 'innate ability' and/or the interaction of this ability with formal education (Welland, 1980). This effect has been taken into account in some studies by reducing the observed earnings differential by 20 to 40 per cent. An assumption that the ability factor accounts for as much as 40 per cent of the differential would reduce the rate of return by about 25 per cent for most programs. However, a recent study (Ashenfelter and Krueger, 1994) suggests that the 'ability factor' has been overestimated and likely is negligible.

The adjustment of forgone earnings, on the assumption that university students would have earned more than the other high school graduates if they had chosen to enter the labour

11 These costs were set at 60 per cent of the direct costs. A ratio of 47 per cent was estimated by a detailed examination of institutional financial statements for calculating the 1960 rates of return (Stager,1968). The higher ratio for subsequent years takes the 1960-75 expansion into account, and permits direct comparison with previous calculations for 1985 (Stager, 1989).

Table A3

Forgone earnings for university undergraduates, by age and gender, Ontario, 1990

Age	Actual[a]	Ability Adjusted[b]	After Tax[c]	Part-time Earnings[d]	Forgone Earnings Private[e]	Total
Males						
19	8537	9903	9428	2200	7228	7703
20	10042	11649	10810	2750	8060	8899
21	11547	13395	12189	3300	8889	10095
22	13050	15138	13503	3850	9653	11288
23	15500	17980	15715	4400	11315	13580
24	17948	20820	17905	4950	12955	15870
Females						
19	6947	7642	7459	1650	5809	5992
20	8098	8908	8587	1980	6607	6928
21	9240	10164	9554	2420	7134	7744
22	10390	11433	10644	2860	7784	8573
23	11888	13077	11900	3300	8600	9777
24	13392	14731	13184	3740	9444	10991

[a] Mean annual employment income of high school graduates.

[b] Actual forgone earnings increased by 16% for males and 10% for females.

[c] Adjusted for federal and provincial (Ontario) income tax.

[d] Mean summer employment earnings, reduced by 20% for unemployment and non-participation.

[e] Private forgone earnings are net of income tax.

Table A4

Costs per full-time student-year for university programs, Ontario, 1990

Program	Student's Costs		Institutional Costs	
	Fees[a]	Books,etc[b]	Direct[c]	Indirect[d]
Humanities, Fine Arts	1890	1250	7160	4296
Social Sciences	1890	1250	7160	4296
Maths, Physical Sciences	1890	1400	7160	4296
Biological Sciences	1890	1500	7160	4296
Commerce	1890	1250	7160	4296
Health Professions[e]	1890	1400	8916	5350
Engineering	2030	1500	9056	5434
Law[e]	1890	1400	7160	4296
Medicine[e]	2330	1800	19895	11937
All Bachelor Degree Programs	1950	1350	7400	4440

[a] Includes tuition and incidental fees.

[b] Includes books, supplies, and transportation.

[c] Tuition and incidental fee revenue, plus basic formula grant ($3,513) multiplied by program weight: Health Professions and Engineering = 2.0; Medicine = 5.0; all others = 1.5.

[d] Indirect costs (depreciation, forgone interest, forgone taxes) are estimated as 60 per cent of the direct costs.

[e] Costs for law graduates are assumed to include three years in social sciences and three years in law school. Costs for medicine graduates are assumed to include two years in biological sciences and four years in medical school.

force rather than university, produces only a minor effect on estimated returns: the returns for engineering and law are increased by about one percentage point, and for humanities it is less than one-half point.

The estimated returns are not very sensitive to the arbitrary assumption that indirect institutional costs are 60 per cent of direct costs; the omission of indirect costs altogether increases the estimated returns by about one percentage point for most of the programs.

Finally, when students were assumed to enter medicine or dentistry programs with three (rather than two) preparatory years, the returns were reduced by slightly more than one percentage point.

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